SECTION 6: DESIGN OF SANITARY SEWER FACILITIES

6.1. PURPOSE

MUPB's intent of this section describes the minimum requirements for design of sanitary sewer facilities. These requirements are listed to ensure that any development/extensions have adequate capacity to transport sanitary sewer from the development throughout the collection system. MUPB requires that planning of gravity sewer mains, force mains and lift stations be based upon ultimate sewershed population and not just the development population, to minimize maintenance and operational costs.

6.2. DESIGN APPROACH & CRITERIA

Proposed construction or expansion of wastewater facilities within the MUPB Service Area shall be in compliance with the approved MUPB Regional Facilities Plan, the Recommended Standards for Wastewater Facilities (Commonly referenced as the 10 State Standards), the MUPB Sewer Use Ordinance, the Kentucky Administrative Regulations (KAR), and guidelines defined in this Manual.

Any person, company, corporation, or other entity proposing to develop land or proposing to install new and/or replacement sanitary sewer facilities within the MUPB Service Area must prepare, for review and approval by MUPB, planning and design documents according to the standards and requirements of this Manual. Planning and construction documents must be prepared and certified by a Professional Engineer licensed in the Commonwealth of Kentucky. The service level of proposed facilities shall be according to design standards referenced in these documents.

6.3. HYDRAULIC LOADINGS

MUPB has established the policy of sizing facilities based upon ultimate sewershed populations. This policy requires the OWNER to design based upon all future flows within the sewershed and not just the proposed development. A total sewershed approach, will reduce the number of lift stations that are required to serve the watershed and in return reduce the maintenance and operational costs for MUPB after development. Future flows are to be based upon current residential, commercial, and industrial uses; and where land is vacant, according to allowable land use, as established by local planning and zoning or based upon additional information yet incorporated into planning or based upon customer demands as outlined in SECTION 3 – Design of Water Facilities.

6.3.1. SEWERSHED POPULATION

A. Sewershed population and projected flow rates shall be calculated as a basis of design for all sanitary sewers. Development site plan(s) shall be incorporated into a topographic map, displaying the proposed development in relationship to the sewershed it is to be incorporated into.

B. Estimated sewershed population shall be based upon a 20-year time period, based upon available land and projected population growth. Current planning and zoning maps shall be utilized to estimate flow rates.

6.3.2. FLOW PROJECTIONS & CAPACITIES

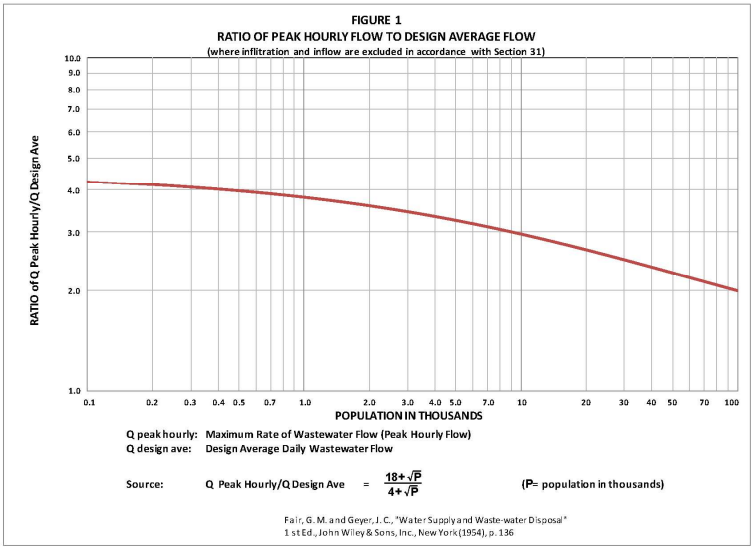
A. In determining the necessary capacity of sanitary sewer facilities, the following factors shall be considered:

1. Peak quantity of domestic sanitary sewer

2. Industrial and/or Commercial sanitary sewer

B. Sanitary Sewer facilities shall be designed on the basis of an average flow with respect to standardized flow rates of residential structures, Equivalent Residential Units (ERUs). Calculations of sanitary sewer generation shall be based upon water demand, see SECTION 3 – Design of Water Facilities.

C. Sanitary Sewer facilities shall be designed to transport peak flows (Q_{peak}). The peaking factor shall be based upon the criteria as shown in RECOMMENDED STANDARDS FOR WASTEWATER FACILITIES (2014 Edition), TEN STATE STANDARDS, Hydraulic Capacity for Wastewater Facilities to Serve New Collection Systems (Figure 1).



D. OWNER may submit an alternate design flow formula/calculation for approval by MUPB. MUPB's decision shall be final.

E. Minimum diameter of gravity sanitary sewer shall be 8-inch, with a maximum distance between manhole-to-manhole of 400 linear feet.

6.3.3. HYDRAULIC MODEL

See SECTIONs 7 & 8 for requirements of hydraulic model for force main, lift stations and/or low-pressure sewer systems.

6.3.4. DESIGN CRITERIA

A. Gravity sanitary sewers shall have a uniform slope and straight alignment between manholes.

B. The diameter of local collection sewer and trunk sewer mains shall be continually increasing, with increase in sewershed flow. Isolated segments shall not be oversized to take advantage of lower minimum slopes, in an attempt to compensate for a lack of natural topographic slope along the route.

C. At all manholes where a smaller diameter sewer discharges into a larger diameter sewer, and at all locations where the sewer main increases in size, the invert of the larger sewer shall be lowered so that the energy gradients of the sewers at the junction are at the same level. Generally, this condition will be met by placing the crowns of the two sewers at the same elevation.

D. Sewers shall be designed to be free flowing with hydraulic grade below the crown of the pipe, and with slopes sufficient to provide an average velocity when running full of not less than 2.0 feet per second. Generally, computation of flows will be based on the Manning's coefficient of friction (Manning's n) equal to 0.013.

E. The maximum permissible velocity at average daily flow is 15 feet per second.

F. **Table 6.1** below lists the minimum slopes to be provided in order to achieve the minimum velocity of 2.0 feet per second or greater at full pipe flow.

Table 6.1 – Minimum Slope

Sewer Size	Minimum Slope
8-inch	0.50
10-inch	0.37
12-inch	0.29
15-inch	0.25
18-inch	0.15

21-inch	0.15
24-inch	0.10
27-inch	0.09
30-inch	0.062
33-inch	0.054
36-inch	0.048
39-inch	0.041
42-inch	0.040

Minimum Slopes are shown in Feet per 100 Feet.

G. The terminal upstream section (manhole to manhole) of a local collection main, a section discharging into a lift station or treatment plant, requires a manhole to be located within ten feet (10') of lift station or treatment plant and have a minimum slope of double to that indicated in **Table 6.1.**

H. For public sewers larger than 42-inch, slopes will be determined on a project specific basis.

I. Maximum slope on all gravity sewers is 10 percent, without written MUPB approval.

6.4. SANITARY SEWER LAYOUT

The following description of sanitary sewer layout shall pertain to gravity sanitary sewer. Plan and profile views are required for all gravity sanitary sewer lines.

6.4.1. Plan View

A. Sanitary sewers of 15-inch or larger diameter are typically considered to be trunk mains or interceptors, such that service connections are not permitted directly to these pipes, without prior approval.

B. Public sewers of 12-inch, 10-inch, and 8-inch diameters are considered to be collection mains, to which service connections may be made along the pipe. These mains may be routed within streets and pavements, or be located in easements on private property, only in accessible portions of the property.

C. Routing for sanitary sewers shall be determined based upon the required separations from utilities and structures, while minimizing the use of manholes, and minimizing the number of crossings with roadways, driveways, curbing, and sidewalks.

D. Sanitary sewer routing and manhole placements shall be chosen such that manholes will be accessible for maintenance operations. All sanitary sewer lines and/or manholes shall be a minimum of ten (10') feet for any structure or foundation.

E. Impediment of existing sanitary sewers for future access and/or maintenance excavation will not be permitted. Any necessary relocation of existing sanitary sewer facilities due to development is the responsibility of the OWNER/CONTRACTOR, and shall be replaced in kind, in the form of a new, parallel facility. Where grading is to occur, resulting cover on existing sewer must remain above design minimum and may be considered excessive if resulting in the total cover in excess of 15 feet.

F. At manholes, the maximum deflection angle between influent and effluent lines is 90-degrees.

G. Separations

1. Provide a minimum 10-foot horizontal separation (outside to outside) with any water main, including at sanitary manholes for parallel installation. For a water line crossing, provide a minimum of 1-1/2 foot vertical separation (outside to outside) with any water main and with a minimum of 1-1/2 foot horizontal separation with the gravity sewer main being below the water main.

   Under no circumstances may any sewer cross beneath a storm drainage structure (retention pond, etc.) or beneath any other above ground or underground structure without MUPB approval.

2. Provide minimum 10-foot horizontal separation with a building or any other above ground structure. This requirement may be increased for deep and/or large diameter sewers, as determined by MUPB.

H. Street Design

1. Manhole location in pavement is preferred. Locate manholes at crown of pavement if possible. Where separation requirements preclude manholes on crown or centerline, manholes should be placed in the center of the traffic lane.

I. Locate all manholes beyond the spread of water from the street's curb and gutter flow.

J. Future Extensions of Sanitary Sewer

MUPB may require access due to future extension of sanitary sewer or if future sanitary sewer service connection appears practical, to allow service to other properties or buildings. Sewer is to be constructed to the limits of the area being developed, so as to terminate in a location from which it can readily be extended in the future. This will be beyond proposed pavements, past adjacent buildings, and beyond adjacent or crossing waterlines or storm drains, ducts, or other utilities that would otherwise be undermined during subsequent sewer installation. Temporary terminations of public sewer will be at a manhole. Easements for the future line(s) must be conveyed, extending to the site or subdivision boundary. Associated temporary construction easement(s) may also be needed, as dictated by the scope of the future installation.

K. Sewers parallel to or crossing streams shall be designed as follows:

1. Sewers and their appurtenances located along streams shall be protected against the 100-year flood. Sewers located along streams shall be located outside of the streambed wherever possible and be sufficiently separated to provide for possible future channel widening.

2. Depending on cover and magnitude of stream, sewers crossing streams may require concrete encasement. Where encasement is determined necessary, encasement shall extend minimum 20 feet beyond the stream bank on each side of the stream. The pipe and joints shall be tested in place, must exhibit zero infiltration, and shall be designed, constructed and protected against anticipated hydraulic and physical stresses; longitudinal, vertical and horizontal loads; and erosion.

3. Sewers parallel to streams shall be of sufficient depth so that tributary extensions can be made under the streams while maintaining adequate cover. Anticipated future extensions must be shown in plan view, and corresponding actual surveyed stream depths will be required for plan review.

L. Elevated sewers are permitted only on a case-by-case situation at the sole discretion of MUPB.

6.4.2. Profile View

A. Maintain a minimum cover of six (6.0) feet. Cover may be reduced to four (4.0) feet in isolated instances at the upper reaches of the system, and where the public sewer is located outside of pavement. Where approved to be at less than four (4.0) feet of cover, sewers may be required to be protected from superimposed loads by means of concrete encasement.

B. Minimum cover at a stream crossing is one (1.0) foot, in a rock streambed or three (3.0) feet, if in soil or alluvium streambed. Concrete encasement may be provided, where cover is less than four (4.0) feet and may be specified wherever needed to ensure that the sewer is not compromised during flooding. Concrete encasement shall be specified for existing or proposed sewer when the sewer is located below rip-rap channel lining or large stone used for slope protection.

C. Maintain minimum vertical separation of 1.5 feet (outside to outside of pipe) and below when crossing a water main or gas main, 2.0 feet (outside to outside of pipe) only if the sewer is above the storm sewer.

D. Show all crossing utilities and specify required clearances for all pipes. Crossings shown in profile must account for pipe wall thicknesses and be labeled with **designed** clearances, not required clearances.

E. Include the following note, prominently displayed on each profile view:

"THE CONTRACTOR SHALL ENSURE THAT SANITARY SEWER IS CONSTRUCTED TO THE APPROVED SLOPES. IF DURING THE AS-BUILT SURVEY, THE SLOPE OF ANY SEWER IS FOUND TO BE INADEQUATE TO CONVEY THE DESIGN FLOW, OR LESS THAN THE MINIMUM PER KENTUCKY REGULATIONS, THE SEWER SHALL BE REINSTALLED TO CORRECT SLOPES AT THE EXPENSE OF THE CONTRACTOR."

F. Sewers installed above existing grade shall be placed in controlled fill. Any gravity sewer main or lateral to be installed in fill areas shall require the OWNER/DEVELOPER to provide on-site inspection and testing services by a Licensed Geotechnical Engineer to ensure that each lift in the proposed trench area was constructed and compacted to 95% Standard Proctor density from bottom of the fill to 30" above the top of the pipe. Copies of all test reports shall be certified by the Geotechnical Engineer and submitted to MUPB prior to pipe installation.

G. Locate sanitary sewers outside of areas supporting foundations of buildings or structures.

H. Specify type of pipe material for each section or branch line. Typical sanitary sewer gravity pipe material shall be PVC SDR-35, ASTM D3034/F679. Pipe material and dimension ratio shall remain constant between manholes.

6.4.3. Easement

A. For public sanitary sewer mains, provide easements with widths no less than twenty (20) feet, centered upon installed pipe and temporary

construction easements with widths no less than forty (40) feet for gravity sanitary sewer mains less than seven (7) feet of depth. For gravity sanitary sewer mains greater than seven (7) feet of depth, shall be provided with easements with widths no less than thirty (30) feet, centered upon installed pipe and temporary construction easements with width no less than fifty (50) feet.

B. Where public sewer runs along a lot line within a subdivision, locate the sewer a minimum of 10 feet from the parcel or lot boundary line. Where public sewer parallels such a lot line, the sewer easement shall be placed on a single parcel boundary, in order to allow MUPB access without impediment of a fence at the property line.

C. Where proposed construction is across land of others, temporary construction easements shall be established in sufficient widths to accommodate the work area.

D. Sanitary sewer mains shall be located in areas (public right-of-way or easements with access adjacent to public right-of-way) with access available through and/or adjacent to proposed roadways. Sanitary sewers laid in the back of properties with access only via entering private property is not permitted; however, a request may be made and will be reviewed by MUPB on a case-by-case situation.

E. Easement plats, instrument of conveyance and/or deed shall be reviewed prior to being executed and filed according to the procedures found in SECTION 2.

F. Should public sewer be installed outside the boundaries of the recorded easement, a Deed of Easement and Easement Vacation with accompanying plat shall be prepared, approved, and recorded, so as to establish the easement at the as-built location(s).

6.4.4. Miscellaneous

A. Show sanitary sewer crossings of other utilities on all applicable profiles.

B. Facilities being decommissioned shall be abandoned and associated easements vacated. Manholes, structures, and appurtenances are to be removed to the depth specified by MUPB.

C. For sewers greater than fifteen (15) feet in depth the pipe material shall be ductile iron with bituminous coated outside and shall receive Protect 401 or equal ceramic epoxy lining on the inside, unless otherwise approved by MUPB.

6.5. MANHOLES

6.5.1. Plan View

A. A manhole shall be provided at each of the following:

1. all junctions, changes in horizontal alignment, changes in gradient, and temporary or permanent terminus of public sewer;

2. every 400 linear foot (maximum distance) of gravity sanitary sewer.

3. changes in pipe diameter;

4. lateral connections for laterals 8-inch diameter and larger.

B. Separation

1. Provide a minimum horizontal separation of 10 feet between exterior of manhole and all potable water mains or lines.

2. Provide minimum 6-foot horizontal separation (outside to outside) with storm structures, drainage piping, duct banks, vaults, and other utility type structures.

3. Do not locate a manhole in a parking space, or where continuous access would otherwise be obstructed.

C. Maximum number of connecting pipes per manhole is four, (one out; three in), with a pipe entering by a drop connection counting as one.

D. Inside diameter of manholes shall be four (4.0) feet for public sewers less than or equal to 12-inch diameter. Manhole diameter requirements for sewers larger than 12-inch diameter but less than 18-inch diameter shall be five (5.0) feet. Manhole diameter requirements for sewers larger than 18-inch shall be approved on a project-specific basis.

E. Provide a minimum of 12 inches between openings (cores).

F. Existing manholes that are to receive a proposed sewer pipe shall be cored or bored. Chiseled or hammered openings shall not allowed.

G. A manhole is required at each temporary termination of the public sewer. In isolated instances, when stubbing out of commercially zoned land which is not fully planned or engineered, plugged stubs of 8-inch diameter may be used. Minimum slope for such a stubbed section shall be 1.00 percent.

6.5.2. Profile View

A. Minimum depth of manhole in shall be 6 feet. Depth may be reduced to four (4.0) feet in isolated instances, and where the public sewer is located outside of pavement. Where approved to be at less than four (4.0) feet of cover, sewers may be required to be protected from superimposed loads by means of concrete encasement.

B. Manhole depth shall not exceed 20 feet. In cases where excessive depth is unavoidable, MUPB, at their discretion, may approve depths greater than 20 feet.

C. Typical drops in elevation between influent and effluent pipe inverts shall be between 0.10 – 0.50 feet.

Drop manholes shall only be used where excessive slope or depth of sanitary sewer would result. Drop manholes shall be used where a drop in invert elevations exceeds two (2) feet, via a precast concrete manhole with an external drop. Interior drop manholes shall only be used for connection to existing manhole for a new sanitary sewer line.

D. “Doghouse” manholes must be preapproved by MUPB.

E. Specify traffic rated frame and cover in proposed or future pavement areas.

F. Specify watertight frame and cover, if less than one (1) foot above the 100-year flood water surface elevation.

G. Provide positive drainage for sanitary manholes located outside of pavement areas.

H. Where future grading can be anticipated, manholes are to be installed to ultimate top of rim elevations, wherever practical. However, where doing so would result in top of rims that are more than 4 feet above the interim grade, manhole tops are to be set to the existing ground elevations.

I. Where grading is being proposed at existing manholes, specify adjustment of tops so as to conform to the new grade. Due to the limited adjustment available within the manhole chimney, the components of the manhole will typically need to be disassembled, and new sections installed to accomplish the necessary stack-out. Joints in new components must be made with dimensions that conform to the joints of existing components, where new and old must intersect. The new assembly will be subject to exfiltration testing, and watertight construction is required. If watertight joining to existing components cannot be attained, the entire manhole must

be replaced.

6.6. LATERAL CONNECTIONS

A. All lateral connections shall be installed with a cleanout installed in the lateral line and the cleanout shall be located at the edge of the permanent easement or public right-of-way.

B. Lateral connections of single-family dwellings shall be made along the sanitary sewer main and not at a manhole unless prior approval by MUPB. Lateral connections of multi-family residential, commercial and industrial premises shall be at a manhole.

C. Commercial and industrial connections that require a grease trap and/or oil/water separator shall connect at a manhole.

D. No sump pumps, gutter drains, yard inlets or other storm water connections shall be discharged into the sanitary sewer.

E. Laterals located within public right-of-way or sanitary sewer easement shall be straight with minimal fittings.

F. Lateral shall be made water tight and marked above grade.

G. Lateral connections made on sanitary sewer main shall be made no less than the centerline of lateral at 45° above the spring line of the sanitary sewer pipe.